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Research Summary

Roller Compacted Concrete for Rapid Pavement Construction

The main objective of this research was to develop high-performance Roller Compacted Concrete (RCC) with enhanced solid skeleton to secure greater workability, mechanical properties, and frost durability.

The study involved the development of a stepwise mixture design methodology to select aggregate proportioning and particle-size distribution of combined aggregates that can secure high packing density and lead to enhanced performance.

RCC mixtures with high packing density of aggregate combination and suitable fresh and hardened properties were used to introduce air-entraining agent (AEA) at different dosages. The effect of binder content, AEA dosage, workability level, adjusted by varying the water-to-solid ratio, mixer type, and compaction energy on RCC performance was evaluated.

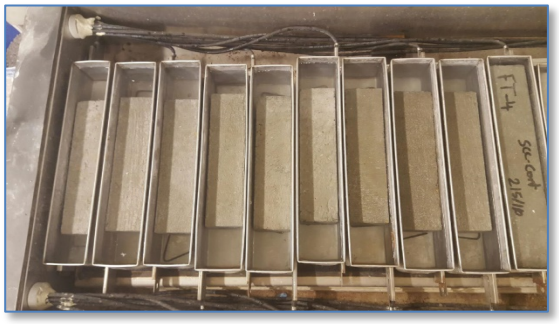
Test results indicate that the performance of RCC can be improved with the increase in packing density of aggregate skeleton. Higher packing density can enable the reduction of cement content through improved compacted structure of the solid particles. RCC mixtures made with 40% sand, 20% intermediate aggregate, and 40% coarse aggregate led to the highest packing density and best workability and mechanical properties.

The binder content, workability level, and compaction technique were shown to affect considerably the mechanical properties, whereas the AEA dosage and mixer type had limited effect. The lowest 28-d compressive strength of 5220 psi (36 MPa) is greater than the 3500 - psi (24.1 - MPa) minimum strength for RCC pavement construction. The highest 28-d compressive strength was 8410 psi (58 MPa).

The spacing factor of RCC mixtures was consistently below the targeted value of 0.009 in. (230 μm) with an air content lower than 7%. The RCC mixtures exhibited a durability factor greater than 70% after 123 freeze-thaw cycles and failed soon after, reflecting marginal frost durability.

Test results confirm the importance of optimizing the PSD of the aggregate skeleton in proportioning RCC as well as the possibility to properly air-entrain RCC.

The incorporation of AEA significantly improved the salt-scaling resistance. The average mass loss of air-entrained RCC mixtures was lower than 11.8 oz/yd^2 (400 g/m^2) after 50 freeze-thaw cycles, which is considerably lower than the limit of 29.5 oz/yd2 (1000 g/m2).



RCC Specimens Prior to Freeze-Thaw Testing

Project Information

PROJECT NAME: RECAST 2B Roller Compacted Concrete

PROJECT START/END DATE: December 2014-September 2017

PROJECT COST: $90,000

LEAD CONTRACTOR: Dr. Kamal Khayat

CO-PRINCIPAL INVESTIGATORS: Dr. Kamal Khayat and Dr. Nicolas Ali Libre

REPORT NAME: Roller Compacted Concrete for Rapid Pavement Construction

REPORT NUMBER: cmr 19-003

REPORT DATE: February 2019

Project Manager

BILL STONE (FORMER RESEARCH ADMINISTRATOR)

For more information, contact Jennifer Harper, current Research Administrator